Amateur Packet Radio

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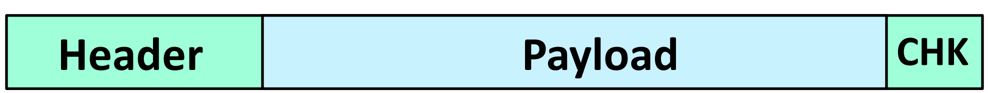
Santa Clara County ARES®/RACES

Agenda

- What is packet radio?
- Why use packet radio?
- Building your personal packet station
- A packet station for a city
- A packet network for a county
- Connectivity beyond the county boundaries …

What is Packet Radio?

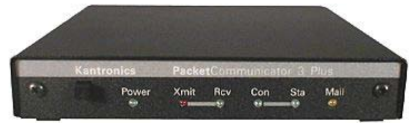
- An amateur mode for sending data over radio
- Uses the AX.25 protocol
  - Similar to X.25 standard; callsigns for addresses
- Sends a packet (envelope + payload) at a time
  - Envelope contains header at beginning and checksum at end
  - Header contains addressing information (to, from)
  - Checksum determines if packet received error-free
  - Payload contains the data to be sent
  - Differs from character-at-a-time, like RTTY, CW, etc.
- Can operate as connection-oriented (reliable) or connection-less (unreliable – use higher-level protocol)
- Typically operates at 1200 or 9600 baud



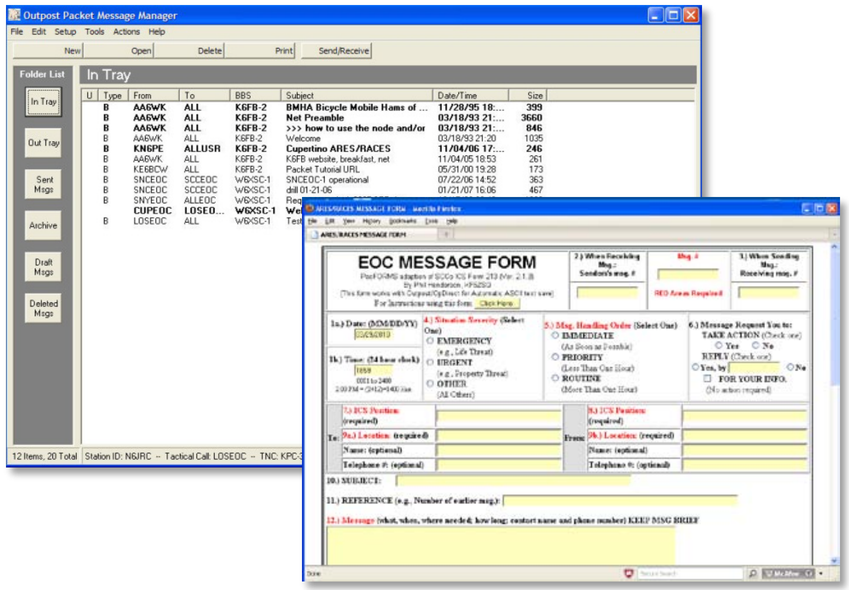
Why Use Packet Radio?

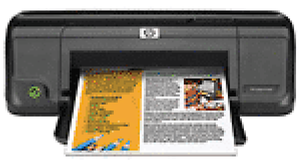
- Long messages
  - We know to keep it under 25 words; served agencies often don't/won't
- Complex messages
  - "Need to swap 22 20-gallon drums of acetalethelhexabadstuff for 4 4-gallon drums of phenylbromotetragoodstuff"
  - Lists of names, addresses, phone numbers, call signs, …
- High volume messages
  - Messages can be transmitted, logged, and printed (multiple copies) much faster than by voice
- Store and forward
  - Recipient does not have to be available at the same time as the sender
- Multiple recipients with acknowledgements
  - "cc:" with auto-acknowledgement, instead of polling each station
- Networking
  - Multiple stations can be networked together for wider covergage – literally, around the world











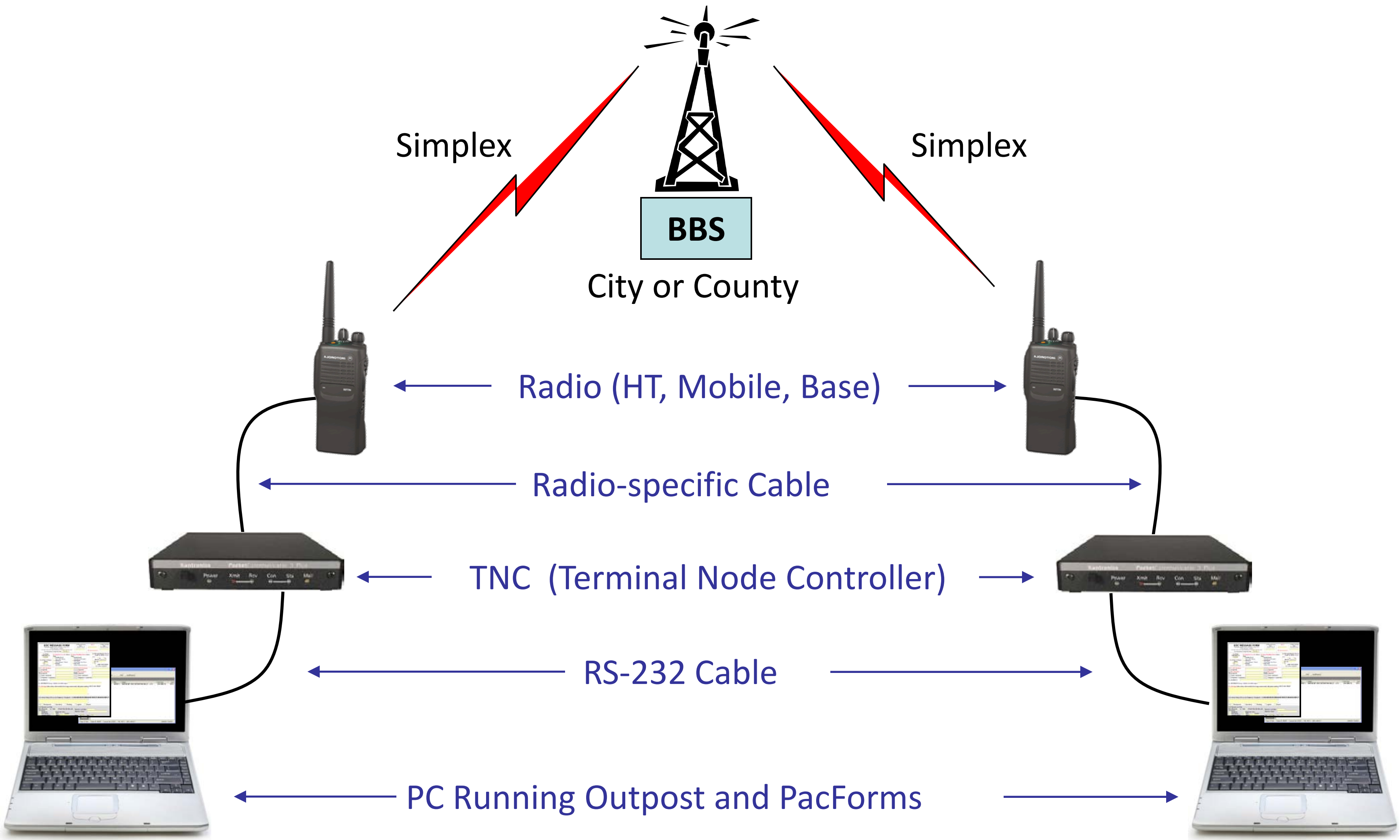


BUILDING A PACKET STATION

Santa Clara County Station Requirements

- Laptop, network or other portable, battery operated style of PC capable of running Outpost and PacFORMS (Windows 2000 or later rec'd)
- Outpost and PacFORMS installed and properly configured according to county standard settings
- Sufficient battery power to operate entire packet station (including PC and printer) continuously for at least one hour on battery)
- USB flash drive (i.e. "USB Key" or "thumbdrive")
- Configured and working 1200 baud TNC
- All appropriate radio, audio and data cables
- Printer for printing messages (rec'd, not req'd)

Packet Radio Components



Computer



- Portability
  - Size, weight
- Readability
  - Screen Size, non-glare
- Power efficient
  - Wattage used, extended battery, 12V power adapter, inverter
- Types
  - Windows (for Outpost)
  - Netbook (ideal)
  - Laptop (better screen & keyboard; uses more power; less portable,)
  - Slate (Windows based for Outpost; lack of keyboard, screen real estate will reduce operator efficiency; not recommended for anything other than personal use)

Other Computer Considerations

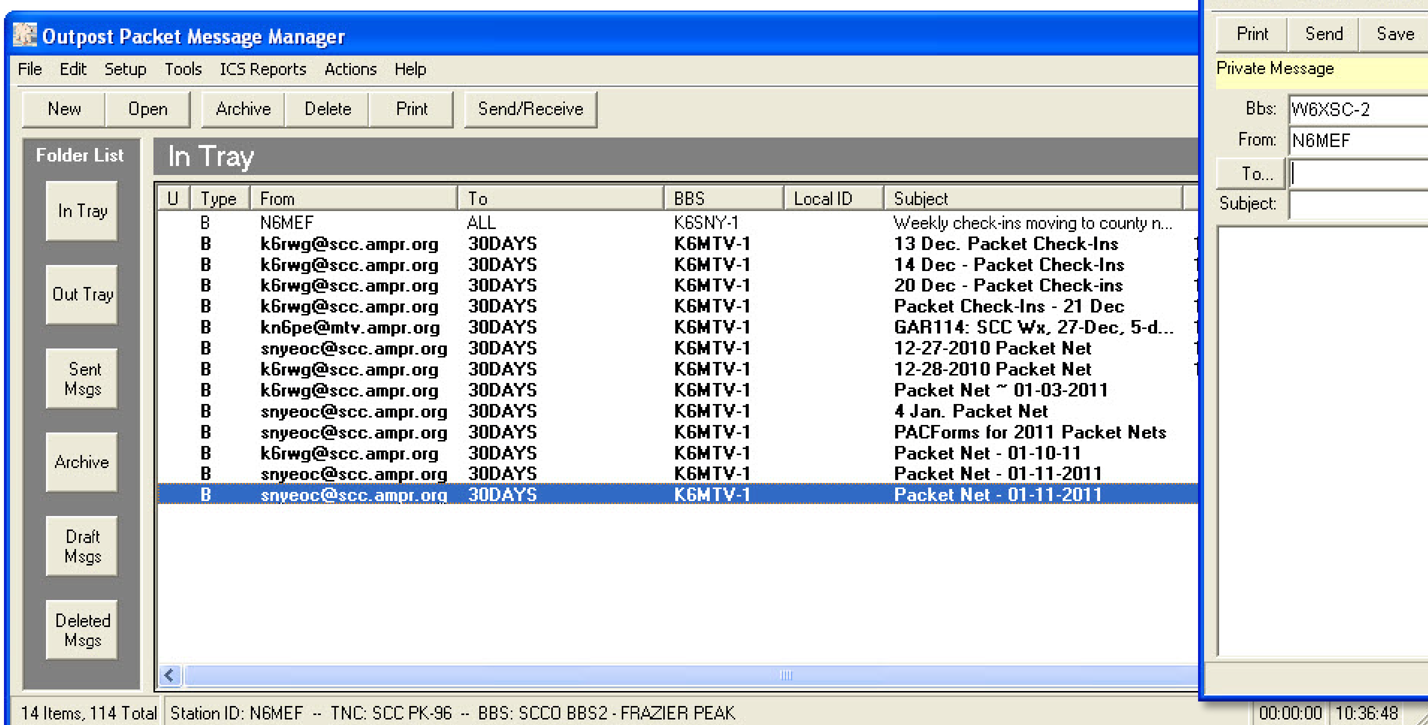
- External Storage for backup, file transfer
  - Hard Drive (power)
  - USB Memory (required)
  - Memory Card
- Printer
  - Power is key! (no laser printers!)
  - Portability
  - Fresh ink cartridges
  - Power
  - Interface

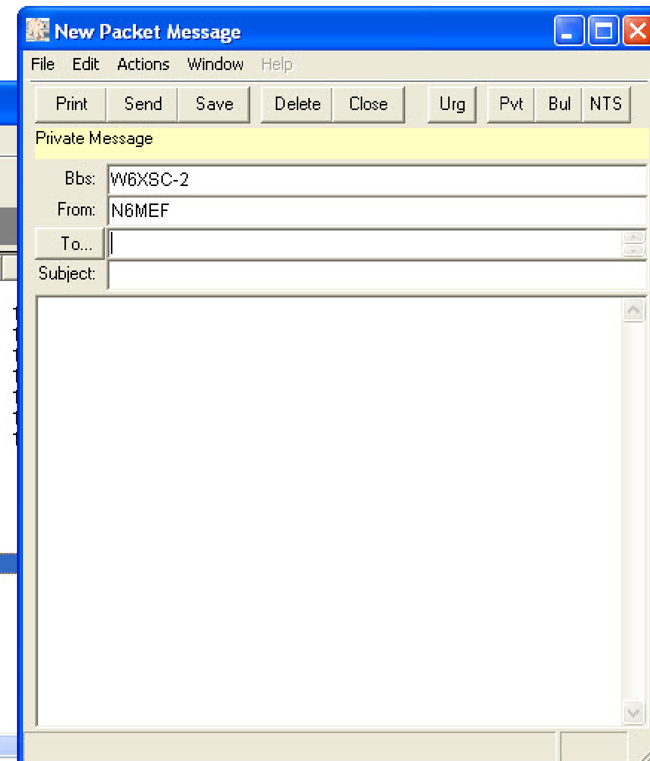




Software - Outpost

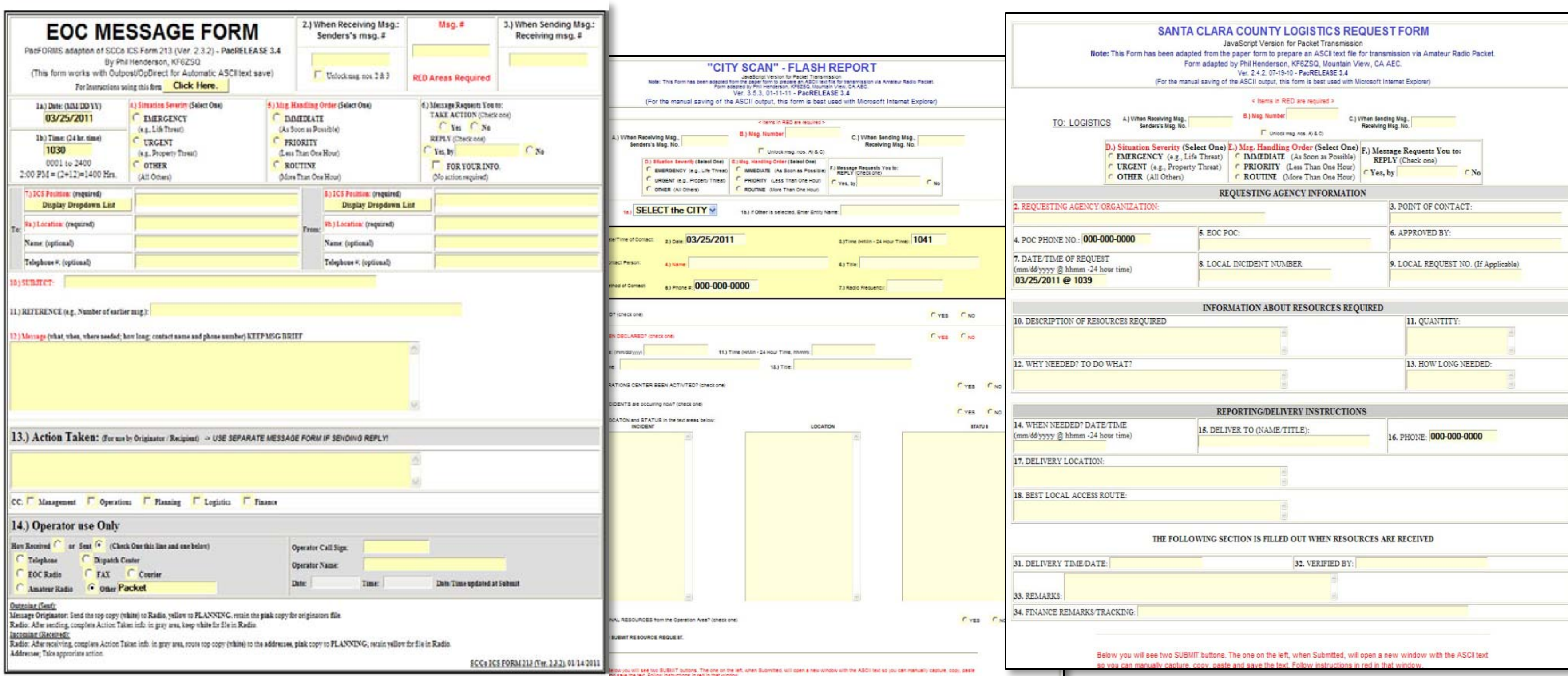
- Easy to use, e-mail like interface
- Folders: Inbox, Outbox, Sent, Archive, Draft, Deleted
- Address book; various automation options
- Automates comms with TNC/BBS – just press Send/Receive
- Produces ICS-309 Communications log





Software - PacFORMS

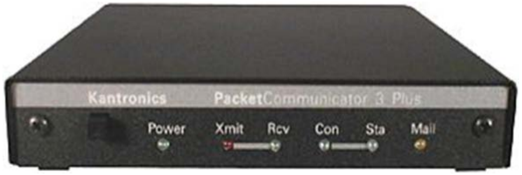
- HTML representation of standard forms
- “Submit” button creates text message in Outpost
- Only data is sent; no formatting
- Upon receipt, form is recreated and displayed, printed, logged



TNC = Terminal Node Controller

- Implements AX.25 protocol
  - Manages AX.25 connections
  - Assembles / disassembles AX.25 packets
- Keys radio PTT
- May include additional functions
  - Personal BBS (PBBS)
  - Node or digi-peater
  - Keyboard-to-keyboard functions
- May be implemented in hardware or software

Hardware TNCs



- Recommended for EmComm work
  - "Out of the box" readiness
- Built-in Personal BBS for backup/emergency BBS
- Full command set includes monitoring, other features
- Typical: DB-25 (or DB-9) serial interface to computer
- Typical: DB-9 (or DIN) audio/PTT interface to radio
- Examples
  - SCCo packet network: Kantronics KPC-3+, Timewave PK-96
  - Other popular options: Kantronics KPC-9612, radios with built-in TNCs

Hardware TNC Feature Examples

Comparison of two popular TNCs

Feature	KPC-3+	PK-96
User Manual	Poorly formatted, hard to use	Well formatted, easy to use
Online Help	Yes	No (keep PDF manual on PC)
9600 Baud (not used very much)	No	Yes
Audio Level Adjustment	XMITLVL command	Manual, via potentiometers
Carrier Detect via Software	Settable via command	Default mode
Command Options	Complete	More levels available; nice, but not really needed
Real Time Clock Chip	Yes (plug-in option)	Yes (plug-in option)

Note: For information only, no endorsement is expressed or implied. The above two TNCs are successfully being used in the SCCo network on a regular basis. Other TNCs may work equally well. Specifications and prices subject to change without notice.

Software TNC Options

- AGWPE = software TNC (www.sv2agw.com)
  - SV2AGW Packet Engine
- Performs many of the TNC functions available in a hardware TNC using software on the PC
- Out of pocket cost: cheap, but offset by lots of tinkering
- Does not have Personal BBS
- Must be manually configured with SCCo settings
- Requires tweaking many settings to make it work and keep it working
- Not ideal for EmComm – not "out of the box" ready
- Connect to radio via:
  - KISS-mode TNC
  - Soundcard (internal or add-on)

AGWPE Radio Interface Options



- KISS mode TNC
  - No built in command set
  - No Personal BBS
  - Simple Data In, Data Out interface
    - May have problems with high traffic situations
  - Requires driver software – AGWPE – for Outpost
  - Examples: TNC-X, MFJ 1270
- Soundcard
  - Requires driver software – AGWPE – for Outpost
  - PC's internal soundcard – subject to levels changes by other applications; audio quality varies in older PCs
  - External USB sound card – can "set and forget" for packet
    - Examples: SignaLink, Buxcomm
  - Needs "tweaking" for proper operation



Selecting a Radio for use with Packet

- 5W HTs work fine for personal use
- For best performance, you need a mobile
  - 25W or more and TALL antenna STRONGLY recommended
    - "Hidden transmitter problem"
      - Can't hear others/others can't hear you -> DOUBLES!
    - Use 25W or more; use as high an antenna as possible
  - Dual receive nice to monitor command channel
    - Or single band radio and use HT
  - Data Connector preferred
    - Consistent transmit/receive audio levels
    - Simultaneously monitor packet traffic on speaker
    - Audio to TNC not affected by squelch
- Dual-band, dual-receive allows monitoring voice channel at the same time

Radios with Built-In TNCs

- Compact – one less component, one less cable
- All in one solution / single point of failure
- Audio levels usually pre-set for optimum performance
- May have complicated menus
- May have operating restrictions/limited functions
  - Example: limited mailbox features, no transmit w/ open squelch, limited simultaneous connections,, …
- Good for personal stations; not so good for BBS
- More expensive





Antenna Considerations



- Probably the most important component
- Packet networks are simplex
- You must be able to hear EVERYONE else on the channel AND they must ALL be able to hear you
  - If not, you WILL cause doubles.
- Get your antenna up as high as possible
- Santa Clara County standard requirement:
  - Dual-band, portable, such as roll-up J-pole
  - Self-standing tripod or other base
  - Mast to support antenna base at least 10' above ground
    - Windsock fiberglass poles can extend to 30+ feet, can easily support a roll-up J-pole, and are very portable.
  - Minimum of 25 feet of coax

Power Requirements for Packet

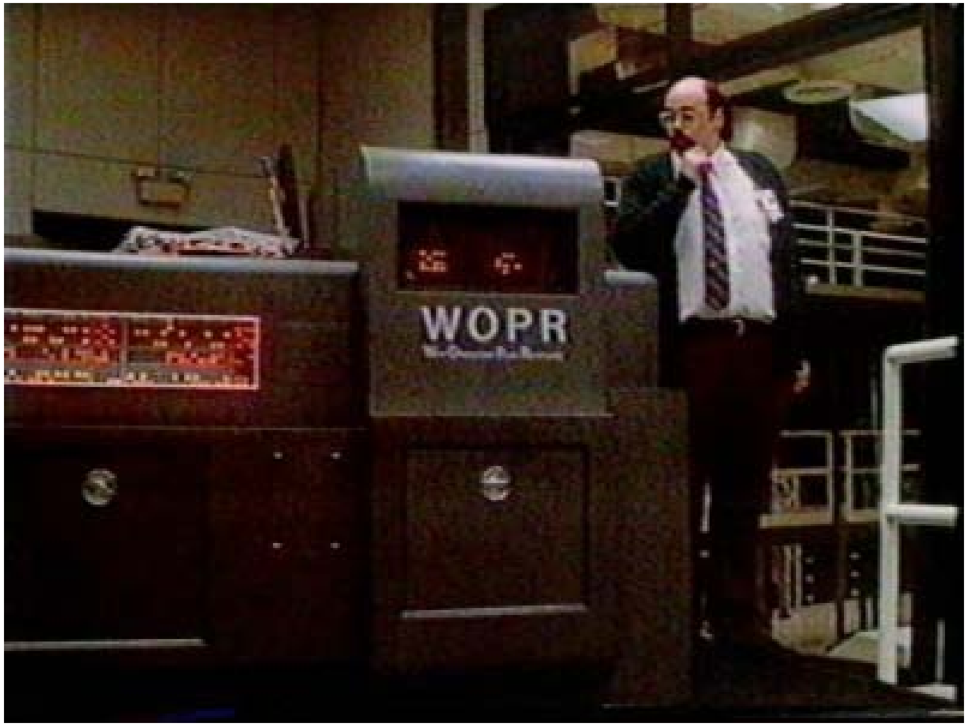


- Devices requiring power:
  - PC
    - Use internal batteries if possible; adapter conversion inefficient)
  - Radio (running minimum of 25 Watts)
  - TNC
    - Recommend against using internal battery (different type)
  - Printer
- MAC P2 equipment requirement
  - "Sufficient battery power to operate entire packet station (including PC and printer) continuously for at least one hour on battery (to handle AC power gaps, generator refueling, etc.)"
- Recommended
  - Charger to restore battery charge when power comes back
  - Keeps station ready for the next power disruption

Battery Power for One Hour Ops

Equipment	Current Needed	Duty Cycle	Amp Hours
Radio RCV	1.2 Amp	50%	0.6
Radio XMT (50W)	10	50%	5.0
TNC	.2	100%	0.2
Laptop (90W)	7.5	100%	7.5
Printer	.5	100%	0.5
		Total AH for 1 Hr	**13.8 AH**

- Capacity needed = 13.8AH
- Battery needed
  - 18 Ah minimum (1/3 de-rating)
  - 26 Ah recommended (1/2 de-rating)
  - **Note:** 24-26AH already recommended in SCCo Go Kit



How to get started

A PACKET STATION FOR A CITY OR CLUB

A Packet Station for a City or Club

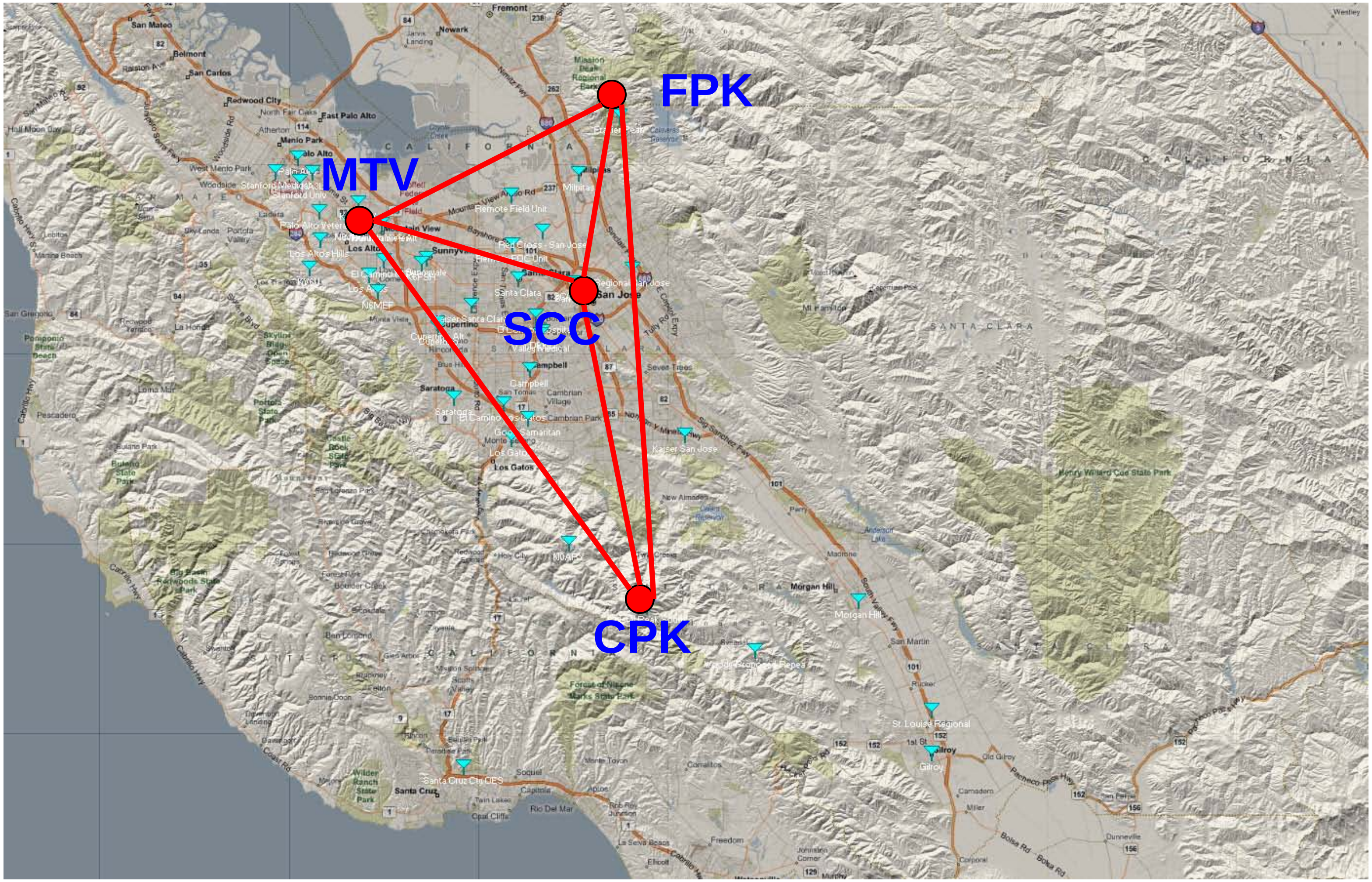
- Can be as simple as a single TNC with built-in PBBS
  - Users can connect and leave messages for single call sign
  - Current models typically limited to 10 concurrent connections (older = 1)
  - Example: City of Los Altos had single TNC solution for years – K6LOS
- Move up to a full PBBS – single frequency
  - Users can connect and leave messages for each other
  - Example: City of San Jose has their own PBBS
  - Popular BBS software:
    - FBB (Jean-Paul Roubelat, F6FBB)
      - http://www.f6fbb.org/
    - BPQ (John Wiseman, G8BPQ)
      - http://www.cantab.net/users/john.wiseman/Documents/
    - JNOS 2.0 (Maiko Langelaar, VE4KLM)
      - http://www.langelaar.net/projects/jnos2/
    - WinLink 2000
      - http://www.winlink.org/
  - JNOS and WinLink can gateway to e-mail
- Network with other BBSs



How to process high volume traffic efficiently

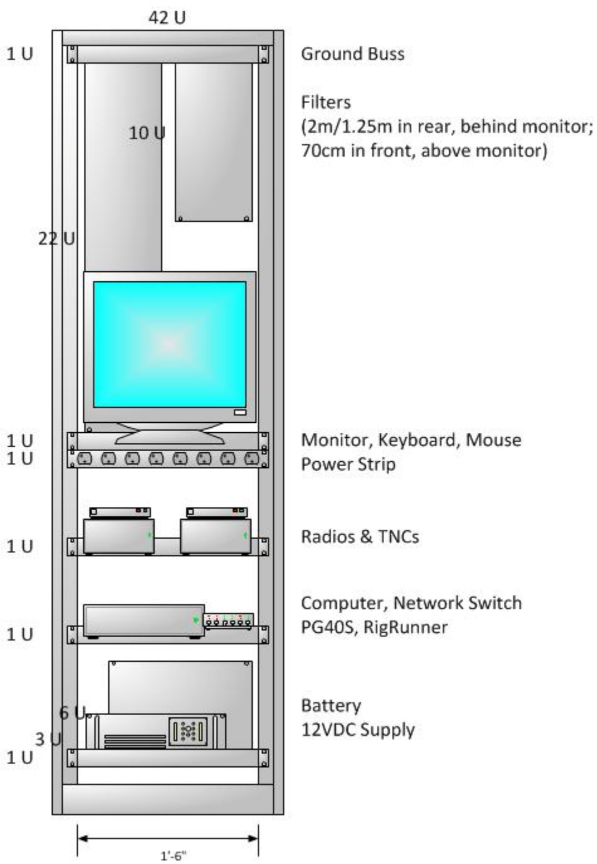
COUNTY PACKET NETWORK OPERATIONS

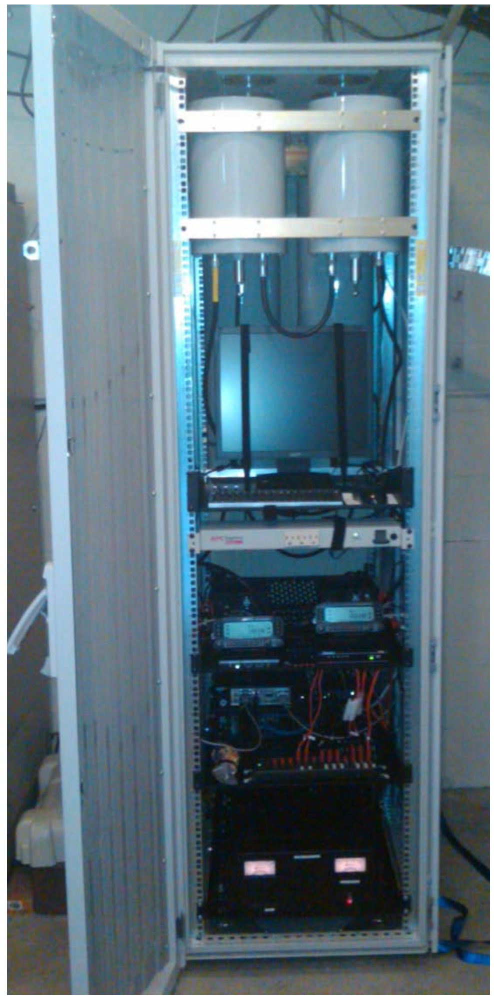
Santa Clara County BBS Network



No Internet required to reach anywhere in the county!

BBS Physical Installation

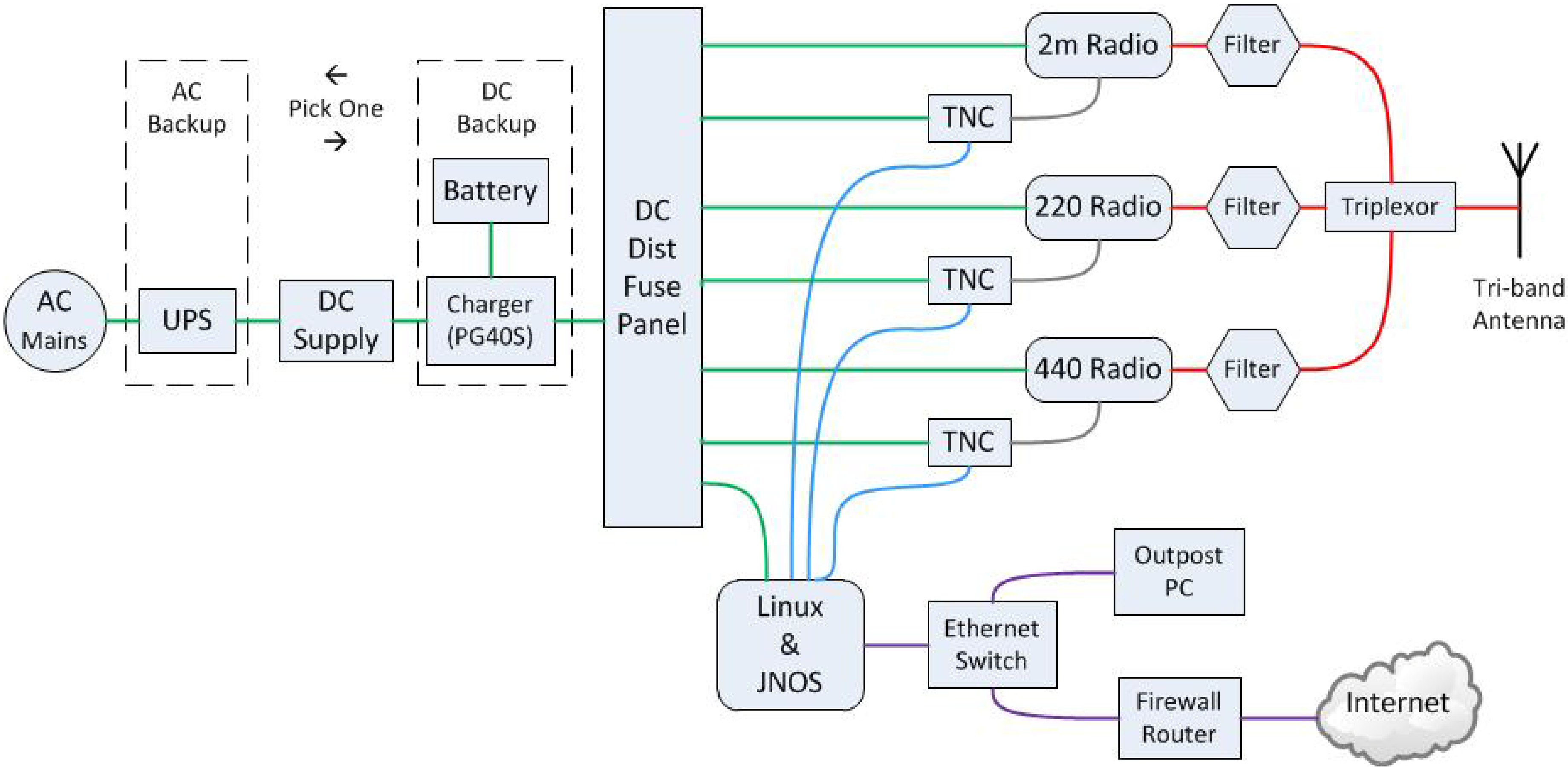








Block Diagram: Typical SCCo BBS



Agency Assignments to Primary/Secondary BBSs

Santa Clara County Backbone BBS Nodes

Backbone BBSs provide routing and other services to all agencies in the county.

Call Sign	Host.Domain	2m Access	1.25m Access	Location	Comments
W6XSC-1	w6xsc-1.ampr.org	144.990	223.620	Santa Clara Co Office Bldg (San Jose)	JNOS; 24/7; UPS
W6XSC-2	w6xsc-2.ampr.org	145.730	-none-	Crystal Peak (South County)	JNOS; 24/7; UPS
W6XSC-3	w6xsc-3.ampr.org	144.310	223.540	Mountain View	JNOS; 24/7; UPS
W6XSC-4	w6xsc-4.ampr.org	145.690	223.560	Frazier Peak (above Milpitas)	JNOS; 24/7; UPS
W6XSC-5	w6xsc-5.ampr.org	varies	varies	Extra - for training, back-up, etc.	JNOS

Contact: The Santa Clara County ARES/RACES Packet Committee manages the country packet backbone nodes. Send e-mail to: pktcmte at scc-ares-races dot org.

BBS Assignments

Connect/Login Instructions:

- **All users:** Connect to the primary BBS for your agency. If the primary is down, connect to the secondary.
- **Individual ARES/RACES users:** Log in with your FCC call sign.
- **Cities and agencies:** Log in with your designated tactical call. Consult your EC if you do not know your tactical call. Agencies within the county may define additional tactical calls beginning with their assigned prefix.

#	Agency	Prefix	Primary BBS *(2.1)*	Secondary BBS *(2.2)*
Santa Clara County Cities and Agencies				
1	CalFire VIPs - Santa Clara Unit	SCU	W6XSC-2	W6XSC-1
2	Campbell, City of	CBL	W6XSC-1	W6XSC-3
3	County Communications Center	CCC	W6XSC-1	W6XSC-3
4	Cupertino, City of	CUP	W6XSC-1	W6XSC-3
5	Gilroy, City of	GIL	W6XSC-2	W6XSC-1
6	Hospitals (all SCCo) & DEOC	HOS	W6XSC-2	W6XSC-1
7	Loma Prieta Region	LMP	W6XSC-1	W6XSC-3
8	Los Altos, City of	LOS	W6XSC-3	W6XSC-1
9	Los Altos Hills, Town of	LAH	W6XSC-3	W6XSC-1
10	Los Gatos, City of	LGT	W6XSC-1	W6XSC-3
11	Los Gatos Red Cross	LGR	W6XSC-1	W6XSC-3
12	Milpitas, City of	MLP	W6XSC-1	W6XSC-3
13	Monte Sereno, City of	MSO	W6XSC-1	W6XSC-3
14	Morgan Hill, City of	MRG	W6XSC-2	W6XSC-1
15	Mountain View, City of	MTV	W6XSC-3	W6XSC-1
16	NASA/Ames	NAM	W6XSC-3	W6XSC-1
17	Palo Alto, City of	PAF	W6XSC-3	W6XSC-1
18	Palo Alto Red Cross	PAR	W6XSC-3	W6XSC-1
19	San Jose, City of	SJC	W6XSC-1	W6XSC-3
20	San Jose Red Cross	SJR	W6XSC-1	W6XSC-3
21	San Jose Water Co	SJW	W6XSC-1	W6XSC-3
22	Santa Clara, City of	SNC	W6XSC-1	W6XSC-3
23	Santa Clara County	XSC	W6XSC-1	W6XSC-3
24	Santa Clara Valley Water District	VWD	W6XSC-1	W6XSC-3
25	Saratoga, City of	SAR	W6XSC-1	W6XSC-3
26	Stanford University	STU	W6XSC-3	W6XSC-1
27	Sunnyvale, City of	SNY	W6XSC-1	W6XSC-3
Other Agencies				
28	CalEMA - Coastal Region	COS	W6XSC-1	
29	Alameda County	XAL	W6XSC-3	
30	Contra Costa County	XCC	W6XSC-1	
31	Marin County	XMR	W6XSC-1	
32	Monterey County	XMY	W6XSC-2	
33	San Benito County	XBE	W6XSC-2	
34	San Francisco County	XSF	W6XSC-1	
35	San Mateo County	XSM	W6XSC-3	
36	Santa Cruz County	XCZ	W6XSC-2	

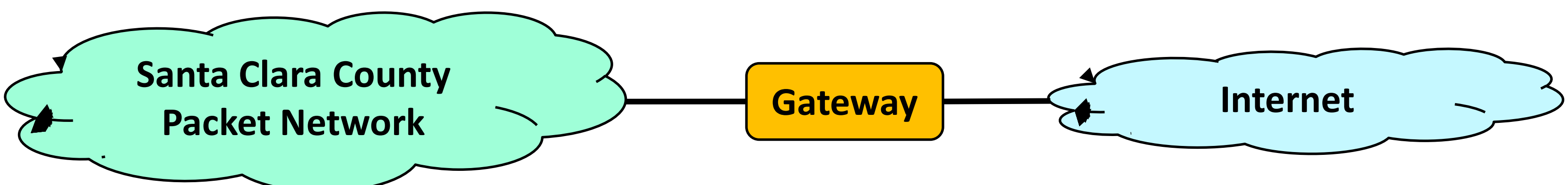
Secondary BBS assignments used if Primary BBS fails

http://www.scc-ares-races.org/packet.html > Packet Frequency and BBS Listings

BEYOND COUNTY BORDERS

Connectivity Beyond County Borders

- Bay Area
  - All surrounding counties and Coastal Region EOC can reach at least one Santa Clara County BBS – no Internet required!
    - Anticipated use: mutual aid; connectivity to CalEMA Coastal Region
  - Tactical calls already installed in all SCCo BBSs
- Wide Area
  - AMPRnet gateway
    - Connectivity between amateur packet stations around the world
    - Uses 44/8 IP addresses; connectivity via IP/IP tunnels
  - E-Mail gateway
    - JNOS already uses SMTP for mail transport
    - E-mail gateway installed for security
  - Traditional BBS network connection via RF



Thank You!

Questions, comments, suggestions?

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